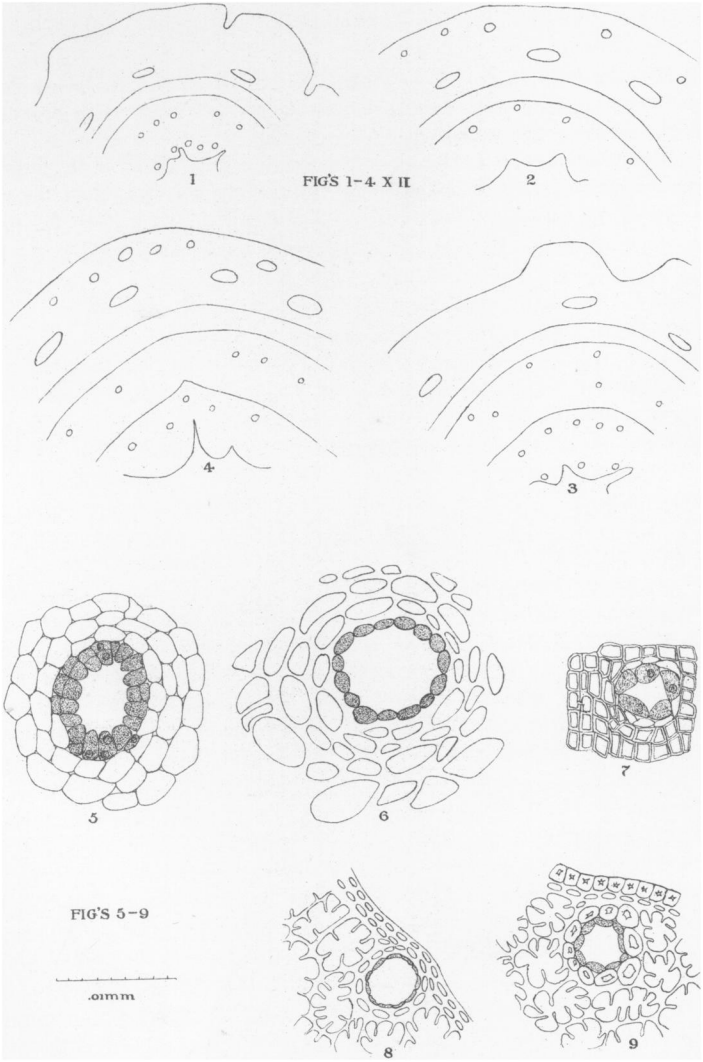
Structure and distribution of Resin Passages of the White Pine.*

ETTA L. KNOWLES.

WITH PLATE VII.

First a study was made of the general structure of the stem and leaf of the white pine (*Pinus Strobus*) with reference to both the relation and structure of different parts. The Scotch pine was studied in the same way and afterwards a comparison made between the two. Stems of one and two years growth were taken of each species and put into alcohol for the purpose of removing resin, and the material thus preserved was ready for use as needed. Leaves of each and young shoots cut at intervals of a few days were treated in the same way. Thin sections were cut, stained with Schulze's Solution and mounted in glycerine. For each point studied sections were taken of a dozen or more different stems. Drawings and measurements were all made with the camera. Upon comparing stems of the two species it was found that the general appearance is much the same, pith at the center and formed about it in successive rings, wood, cambium, phloem, cortex and epidermis, the main difference being that in the Scotch pine there is but one row of resin passages in the cortex and two rows in each year's growth in the wood, while in the white pine there are two rows or rings in the cortex and one row in each year's growth in the wood. In the cortex of the white pine the number of resin passages was found in some instances to be as high as 47 in a stem of one year's growth, while in the Scotch pine 9 or 10 seemed to be the limit. Figures 1, Scotch pine, and 2, white pine, show the distribution and arrangement of the resin passages in the two species in stems of one year's growth; figs. 3, Scotch pine, and 4, white pine, show the same for stems of two years' growth. Taking stems of the two species of as nearly the same diameter as possible, it was found that in the cortex of white pine stems of one year's growth the number of resin passages ranged from 20 to 47, the average being about 33. The number in the wood was more uniform and averaged about 13, giving an average of about 46 in a stem of one year's growth in white pine. In the Scotch pine the average for the wood was found to be 33 and for cortex 10, or about 43 for both wood and cortex. In the Scotch pine one ring is irregular in outline and lies just within the wood surrounding the pith, as seen in figs. 1 and 3. The average

*Selected for publication from original work of students in the botanical laboratory of the University of Michigan, 1885-'86.



KNOWLES ON RESIN PASSAGES.

number for this ring was found to be 18. Taking the second year's growth in the same way the average number for cortex of white pine is 28 and for wood 27, or 55 for wood and cortex. Scotch pine for cortex 9 and for wood 37, or 46 for wood and cortex. From this it will be seen that the number of resin passages varies greatly with the individual as well as with the species.

Shoots of present year's growth taken from the tree at intervals of a few days, from April 30 to May 30, showed little change except in the increased growth of the woody portion. In the cortex there were found as high as 47 resin passages, the average being 38, but no traces of them could be seen in the wood. In shoots taken from the tree June 21, the woody portion had united to form a ring and two resin passages were found, one apparently just formed and still in the cambium, just at the line where wood and cambium meet. It was much larger than mature resin passages in the wood, the growth of the parts around not having compressed it. Resin passages in the wood of the white pine do not begin to form until about the last of June.

Resin passages in the cortex of the young shoot of the white pine are cylindrical and have no walls of their own, being bounded simply by the surrounding cells, which are all thin-walled. Fig. 5 represents a passage found in a shoot cut from the tree May 6. As the stem grows, the tube, small at first, may become larger by division of the cells adjoining it. After a time it becomes lined with thin-walled epithelium, the cells of which project into its cavity, the walls of the cells outside the epithelium thicken and by the pressure of the parts about it as the stem grows, the larger passages are pressed into an elliptical form as seen in cross sections. It is at last, then, a cylindrical or flattened cylindrical passage lined with thin-walled epithelium, which is surrounded by a layer or more of thick-walled cells.

A large resin passage is situated opposite each vascular bundle, while the passages near the epidermis are much smaller. From May 6th (fig. 5) up to May 30th there was little change observed, but by June 21st the passages in the cortex seemed to be nearly or quite developed, looking very much as is shown in a passage from a stem of a year's growth, fig. 6, the walls of the surrounding cells having become very thick.

The structure of the resin passages in the wood is different from that in the bark. They are much smaller. There is the same lining of epithelium, surrounded in this case by one layer of thin-walled cells, which come in contact with the tracheides, the layers of the thick-walled cells being wanting.

Comparing the resin passages in the leaves of the two species

the number for the comparatively tender and delicate leaf of the white pine was found to be from 2 to 3; the number in the Scotch pine from 5 to 8. They are nearer the surface in the leaf of the white pine, fig. 8, than they are in the leaf of the Scotch pine, fig. 9, the bounding cells in the former coming in contact with the epidermal cells.

The structure seems to more closely resemble that of the passage in the cortex than of that in the wood. There is the same lining of epithelium, very thin-walled, and the surrounding thick-walled cells, one layer in the case of the leaf, the surrounding layer being thicker in the leaf of the Scotch pine than in that of the white pine. The cells lining the resin passages of cortex, wood and leaf, form resin which they afterward pour into this canal. The cells surrounding the epithelium were found to contain a large amount of starch. The walls of these surrounding cells seemed to be thicker before growth started in the spring than afterward, sections cut from the tree in February showing thicker walled cells than those cut in April or May.

Notes on Campanula Medium.

BOLLING W. BARTON.

The plant upon which observations were made does not correspond satisfactorily with figures or description of this species, but I am assured by the best authority that it is nevertheless Campanula Medium. Only a single plant was under notice, and already many of its flowers had so far passed that the determination of several details of conduct of promising interest had to be deferred.

The flowers in question are of a delicate pink or rose color. The corolla tube is about $1\frac{1}{4}$ inches in length and $\frac{3}{4}$ inch wide at the mouth, and is not spreading like those of most of the genus, but is more cylindrical, being slightly constricted about halfway down the tube. The inside of the tube is entirely destitute of hairs. Reflexed lobes from between the sepals quite conceal the ovary. The flowers are uniformly erect and not horizontal or drooping, as is characteristic of many species. This character holds good until the corolla withers, when it may incline somewhat to one side. For the rest the structure is essentially like that of other species of Campanula, the peculiarities being the expanded base of the filaments fitting over the ovary and the linear introrse anthers, which lose their pollen on the hairy style as the flower unfolds, a good example of proterandy. Attention